Railway Bridges


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Investigation of Railway Bridges

To Know

- Flow Characteristics

- Sub Soil condition

- Alternative Sites

- Aesthetics

- Cost :Economics

AIMS

- Satisfy traffic demand

- The stream

- Safety

- Aesthetic

" Thorough Investigation means half the work done"

SITES SELECTION

- *Straight reach*
- *Steady river flaw (whirl & eddies)*
- *Narrow cross-section*
- *Bank height above HFL*
- *No sharp curves on approaches*
- *Expensive river training works not required*
- *Do not require excessive under water construction*

DATA COLLECTION SUB-SOIL INVESTIGATION

HYDROLOGICAL DETAILS

- 50 years cycle of flood discharge
- Design discharge
- Linear water way= L

$$L = C / Q$$

C - Constant Normally - 4.75 to 6.3

Q - Discharge in cum/sec.

Afflux

= X in mt.

$$X = V^2 /2g \{L^2/c^2 L_1^2 -1\}$$

V= Velocity in on/sec

L= Width of stream at HFL in m.

L_1=Linear Water way available at Bridge site.

C - Constant= 0.7- 0.9

SCOUR DEPTH AND FOUNDATION

$D = 0.473 (Q/f)^{1/3}$

D= Scour Depth from HFL in m

Q= Design discharge in cumecs

F= Lacey's silt factor (1.0 to 1.5)

Linear water way = l If it is < required L then 'd' to be increased = $\{L/l\}^{0.67}$

Max. depth of scour D=2d

So max. scour level HFL-D

SELECTIION OF BRIDGE

- *Alignment*
- *Bridges for local drainage*
- *Cushion*
- *Cost*
- *View*
- *Soil consideration*
- *Bridge in Hilly area/Coastal area*

CONSTRUCTION OF BRIDGES

- ***Super Structure***
- ***Sub structure***
- ***Protective Works***

SETTING OUT WORKS

- ***Minor Bridges***
- ***Major Bridges***

CONSTRUCTION WORK

- ***MINOR BRIDGES***

- ***Hume pipe***
- ***Box culverts***
- ***RCC/PSC slab***
- ***Simple RSJ or Steel Girder***

MAJOR BRIDGES

- Sub-structure
- Well foundation

  - Circular
  - Double ‘D’ type

- Well curb and cutting edge
- Bottom Plug
- Top Plug
- Well Steining
- Well cap

PROBLEMS IN WELL SINKING

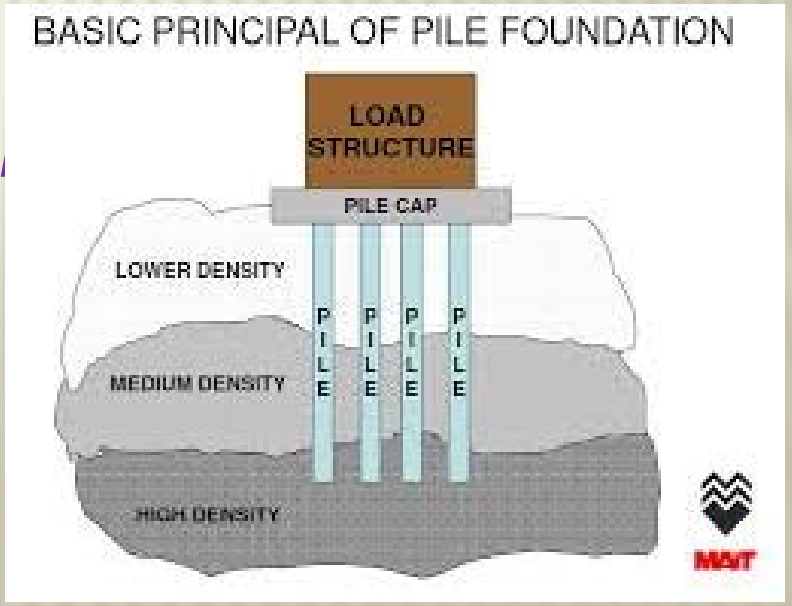
- ***Tilt Eccentric (kentlede, dredging)***
  Max. tilt 1 in 100
- ***Shift***
- ***Blowing of sand***

PILE FOUNDATION

- *Friction piles (Based on Transfer Load)*
- *Bearing piles*
- *Bearing cum friction piles*

Based on Construction Method

- *Driven- Pre cast, cost in situ*
- *Bored- Cast in 'Situ, compact p*



Based on material of Construction

Timber, Steel & RCC piles

SELECTION OF TYPES OF PILES

- *Availability of space & Headroom*
- *Proximity of structure*
- *Reliability*
- *Limitation of Length (25-30m)*

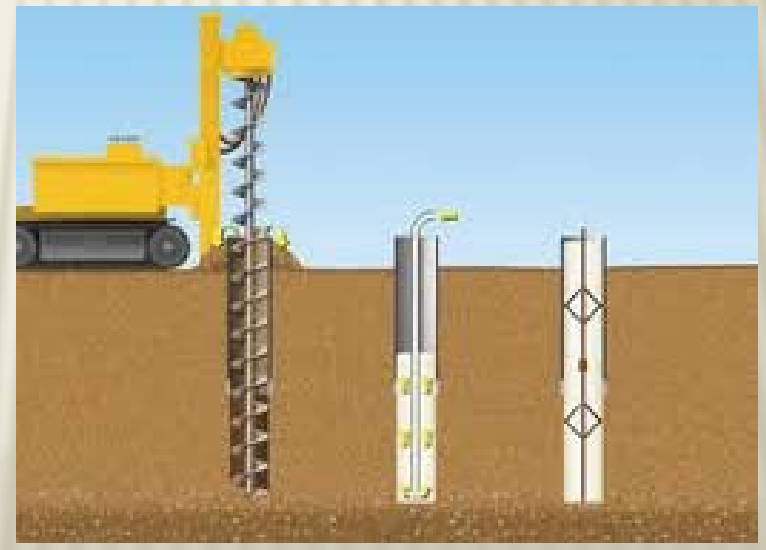
SOIL EXPLORATION FOR DESIGN & CONSTRUCTION

- *Ground water table*
- *Soil profile & bore hold logs*
- *In Situ-Bulk & Dry density soil*
- *Index properties of soil*
- *Shear properties of soil*
- *Consolidation properties*

Spacing- 2.5 to 4 times dia of pile

CONSTRUCTION OF PILE FOUNDATION

- *Driven precast piles*
- *Driven cast in situ piles*
- *Bored cast in situ piles*



CONSTRUCTION OF SUPER STRUCTURE

- *Slab Bridges*
- *Arch Bridge*
- *RCC/PSC Bridges*

ERECTION OF GIRDER BRIDGES

- *Site Condition*
- *Access to site*
- *Availability of Bridging equipment*

ERECTION METHODS

- *Using Cranes (upto 30.5 m span*
- *Erection with derrick*
- *End launching*
- *Side Slew*

INSPECTION OF BRIDES

- *Flooring & Foundations*
- *Masonry in substructure*
- *Protective works*
- *Girder alignment & seating*
- *Structural condition of girders*
- *Welded girders*
- *Condition of steel works.*
- *Inspection of Road over Bridges.*
- *Inspection of Road under Bridges*
- *Inspection of concrete Bridges (RCC & PSC)*

NUMERICAL RATING SYSTEM (NRS)

- ***Unique Rating Number (Physical Condition of Bridge)***
- ***Lower The URN- More serious***
- ***Based on condition no components & condition rating number - CRN***

Condition

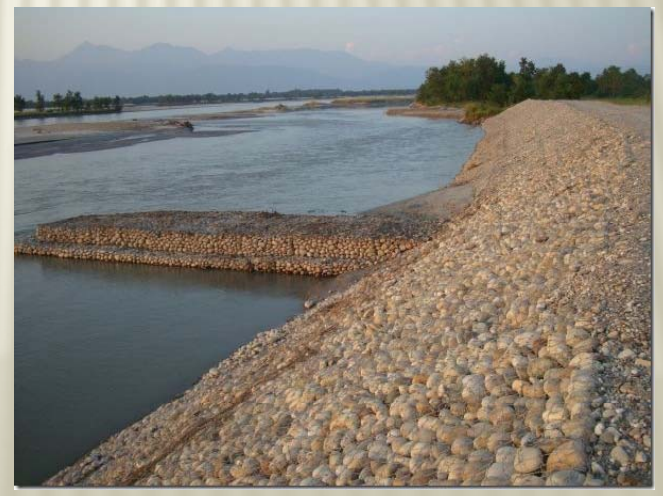
1. ***Warrants immediate Rebuilding/Rehabilitation***
2. ***Required Rebuilding/Rehabilitation on programmed basis.***
3. ***Require major/special repair***
4. ***Routine maintenance***
5. ***Sound condition***
6. ***Not applicable***
7. ***Not inspected***

MAINTENANCE OF BRIDGES

- *Types- Routine & Need based.*
- *Protective works, substructure & super structure*

Protective Works

- *Guide Bunds, Marginal Bunds, Spurs, Aprons, Cut offs, Approach Banks.*
- *Shallow & Deep foundations.*
- *Water Ways*
- *Arches*
- *PSC/RCC & Steel Structure*



CORROSION & PREVENTION

- *Uniform over large areas*
- *Minute areas*

PREVENTING

- *Protective Coating*
- *Metalising*
- *Epoxy based paints*

COMMON REPAIR TECHNIQUES

- *Cement Grouting*
- *Epoxy Grouting*
- *Short creating or Grouting*

STRENGTHENING OF BRIDGES

- *BGML loading (Till 1975)*
- *RBG loading*
- *MBG 1989 (Heavy Mineral Loading)*
- *Sub structure strengthening- Revised Force*
- *Super-structure strengthening- Adding More Plates*

Maintenance of Bed Blocks

REHABILITATION OF BRIDGES

- *Physical Distress*
- *Vulnerability on Hydrological Considerations*
- *Use of Non-standard Materials*

  - *Early Steel Girders*
  - *Laterite Stones*
  - *Cast iron Screw Piles*
  - *Corrugated Steel Sheet piles*
  - *Earthenware pipes*

Categories of Distress Bridges

- *Cat-I & Cat-II*
- *Immediate Rehabilitation*
- *Rehabilitation on prorammed basis.*

EXECUTION OF REHABILTATION WORK

- *Replacement of CI Screw Pipes*
- *Settlement of foundation in piers & Abu*
- *Excessive Scour*

- *Repairs to Bed Blocks*
- *Distressed Arch Bridges*
- *Replacement of Non-Standard/Early Steel Girders*
- *Replacement of Pipe Girders.*
- *Replacement of Small pipes.*

Distress in Super Structure

- *Distress in Slabs*
- *Distress in Girders*
- *Heavy Corrosion - Regirdering*
- *Loose Rivets- Use Turn Bolts & Replace rivets*
- *PSC/RCC slabs – Epoxy Grouting*
- *Weak Girder- Due to heavy loading*
    - *Change vertical members*
    - *Modification in members*

- *Gauge Conversion - Use Standard Spans, Replacement members/Strengthening Members*